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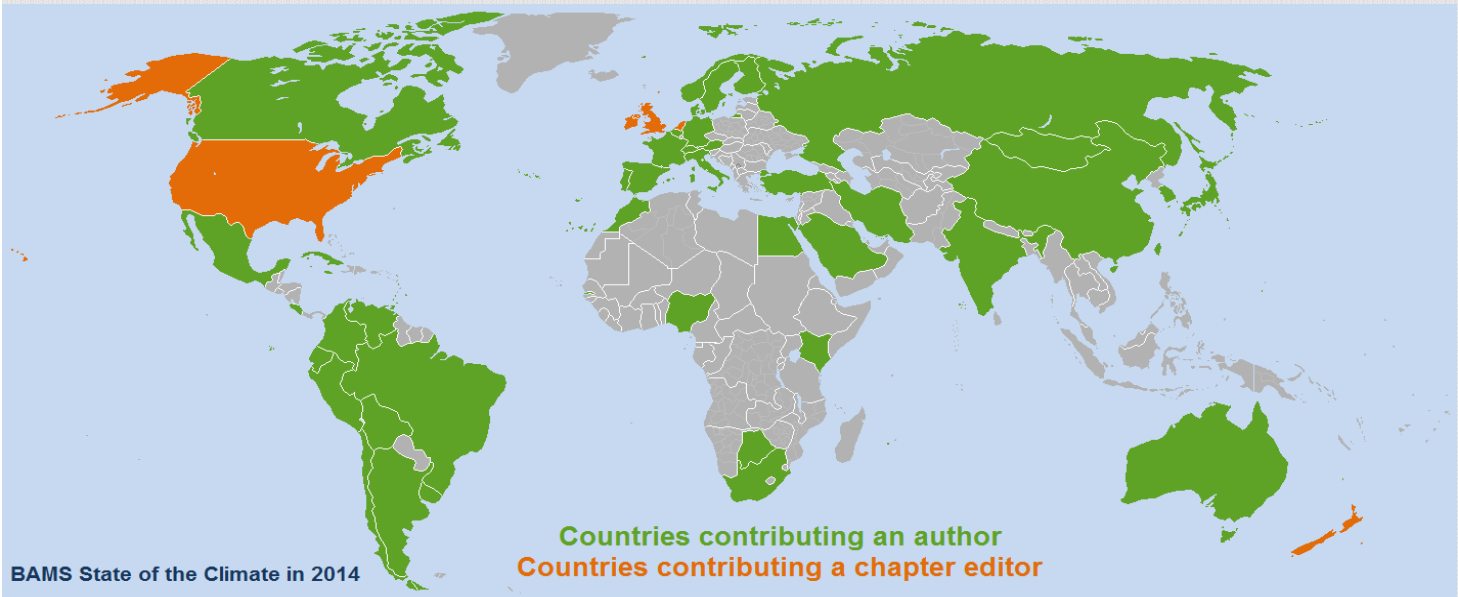
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- Many scientists from many disciplines from around the world fit the pieces of Earth’s climate system and its changes together to connect the dots:
  - Dozens of essential climate indicators, extreme weather and climate events, historical context.
- This report does not pursue “attribution” or contain forecasts, scenarios, or projections.



# Atmosphere

A photograph of a clear blue sky with several white, fluffy clouds scattered across it. The clouds are of various sizes and shapes, some appearing as small tufts and others as larger, more developed masses. The sky is a deep, vibrant blue, and the overall scene is bright and clear.

Land



# Oceans

# Snow and Ice

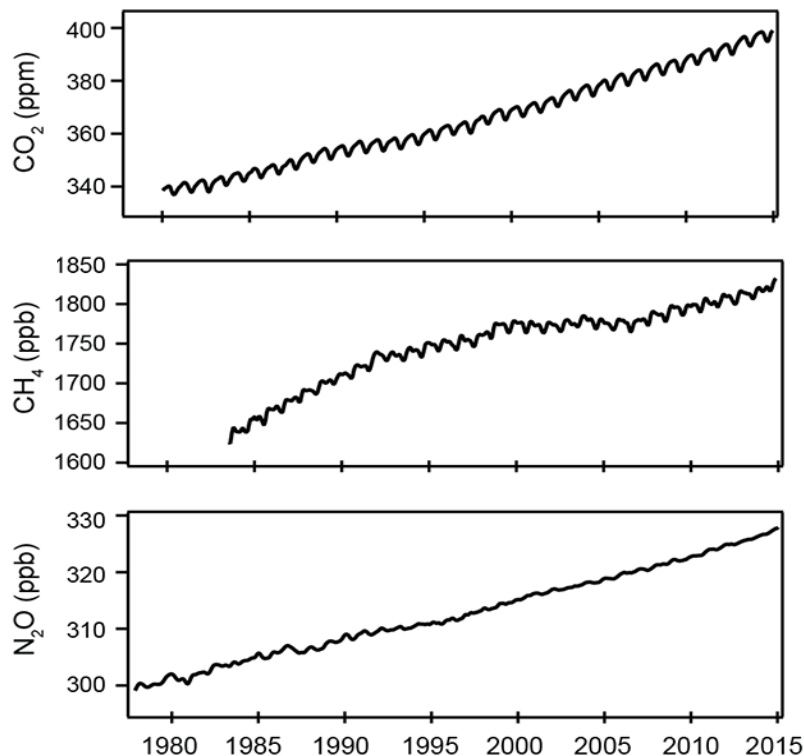
A wide expanse of a frozen body of water, likely a lake or sea, covered in numerous large, irregular ice floes and smaller chunks of ice. The horizon is visible in the distance under a clear sky.

413 authors from 58 countries; 17 editors on 3 continents

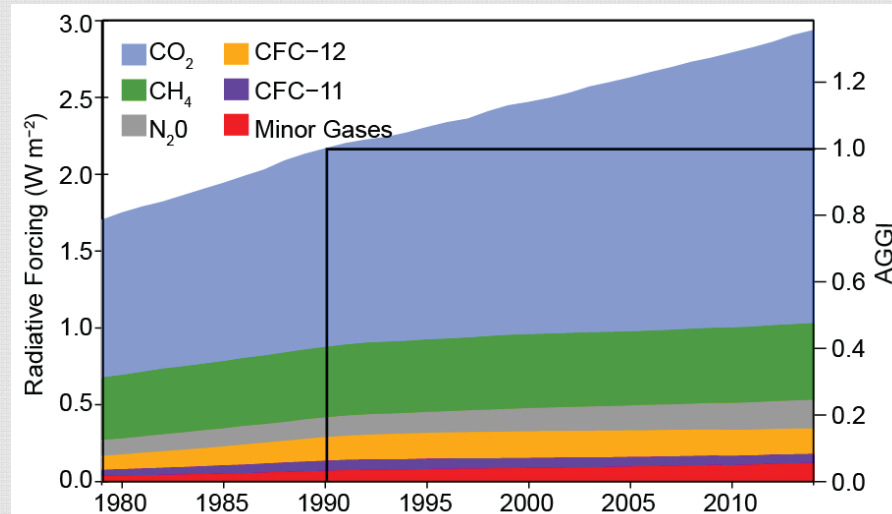




# Greenhouse Gases Reach New Record Highs



- Global mean carbon dioxide (CO<sub>2</sub>) reached 397.2 ppm, a 1.9 ppm increase from 2013.
- Global mean methane (CH<sub>4</sub>) reached 1822.9 ppb, a 9.2 ppb increase since 2013. Largest increase in recent years.
- Global mean nitrous oxide (N<sub>2</sub>O) reached 326.9 ppb, a 1.0 ppb increase since 2013.

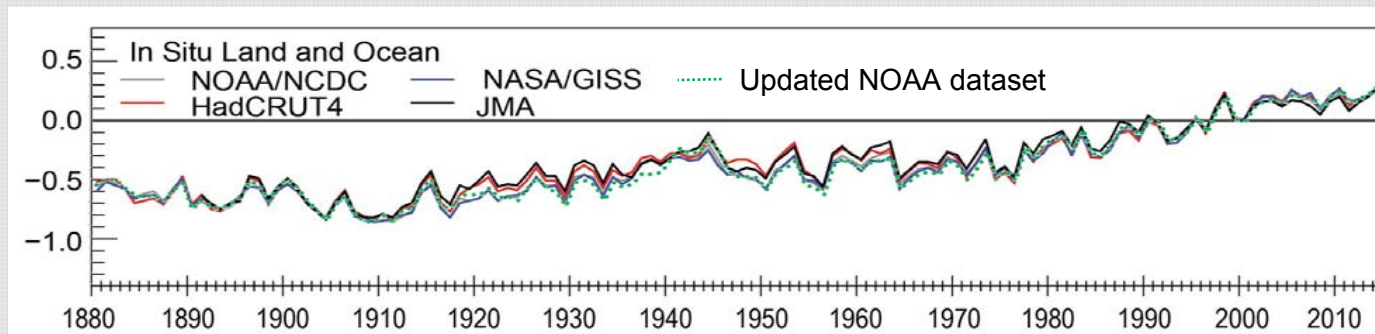


- Additional radiative forcing from greenhouse gases above preindustrial times is now 2.94 W/m<sup>2</sup>, a 36% increase since 1990.
- CO<sub>2</sub> contributes to about 2/3 of this forcing.

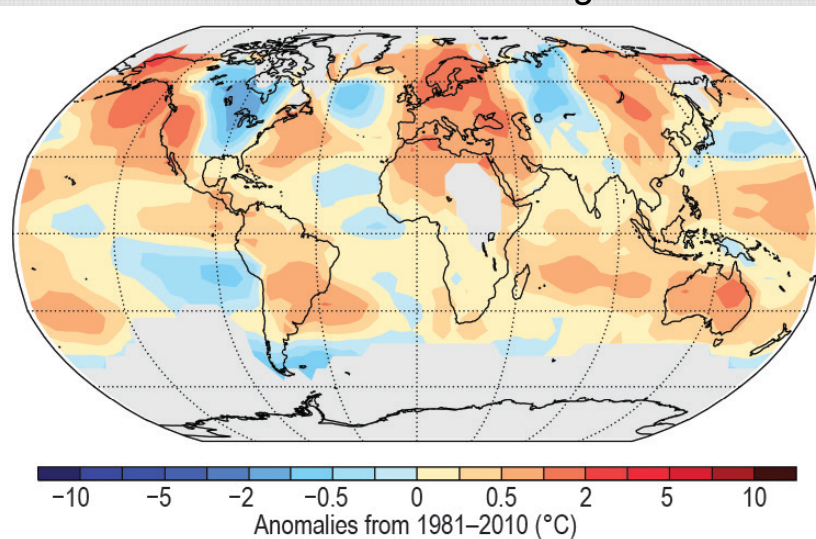


# Global Surface Temperature Reaches Record High for 2014

Four major independent datasets show 2014 was the warmest year since records began in 1880



NOAA: Annual Average

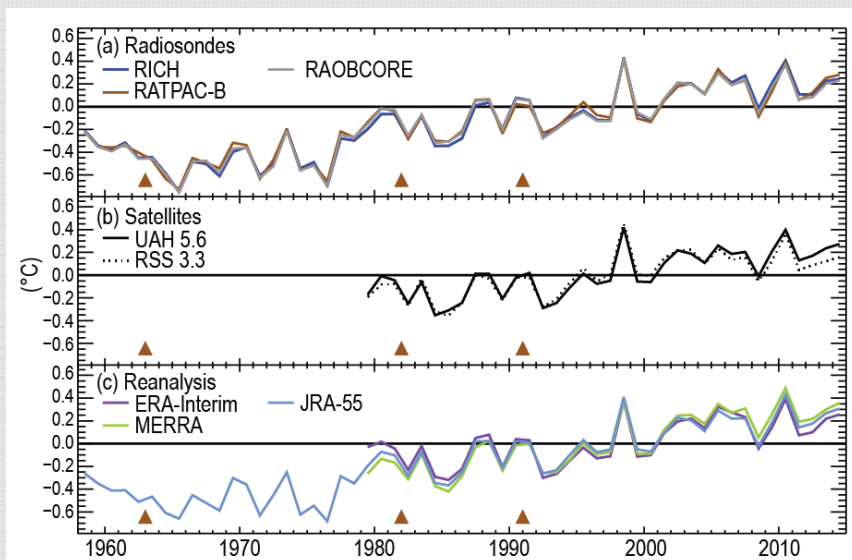




# Upper Atmosphere Temperatures Followed Long-Term Trends

## Lower Troposphere:

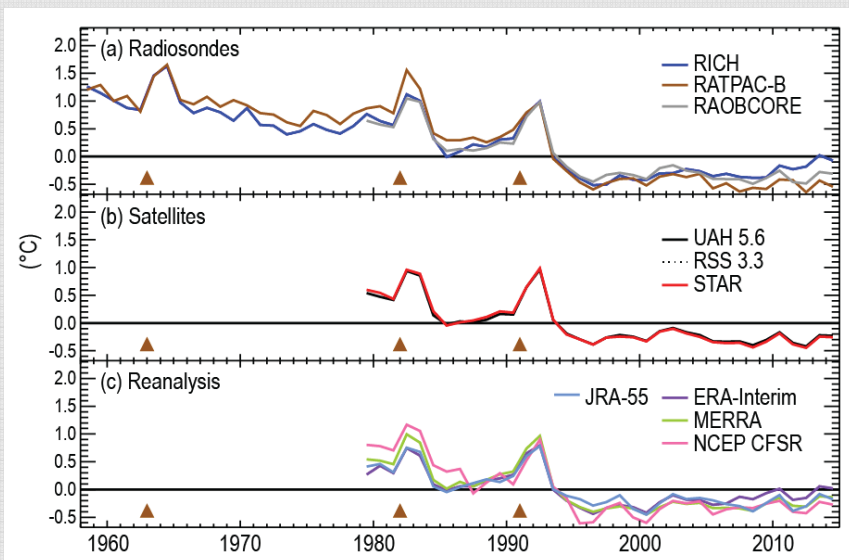
Up to ~6 miles above Earth's surface



3<sup>rd</sup> to 8<sup>th</sup> warmest in 36-year period of record, depending on dataset

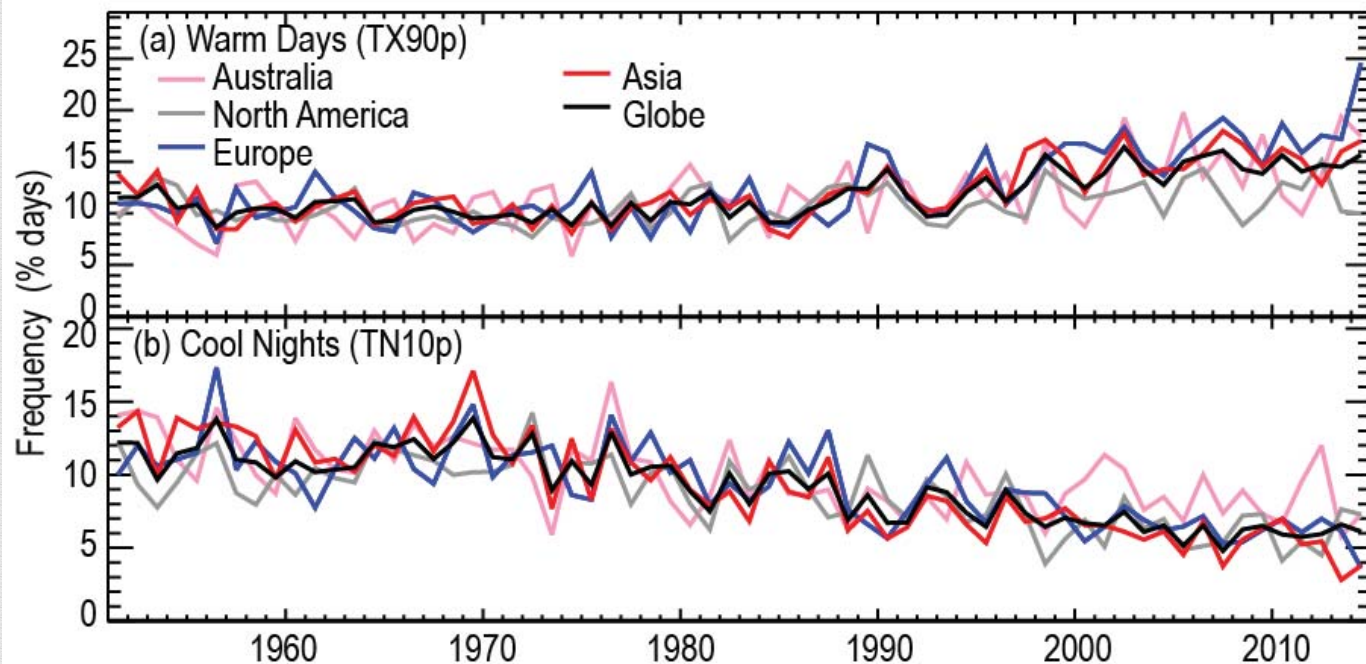
## Lower Stratosphere:

Layer ~7-16 miles above Earth's surface



2014 was slightly cooler than 2013.  
All estimates indicate below-average annual temperature

# Extreme Warm Days are Increasing Extreme Cold Nights are Decreasing

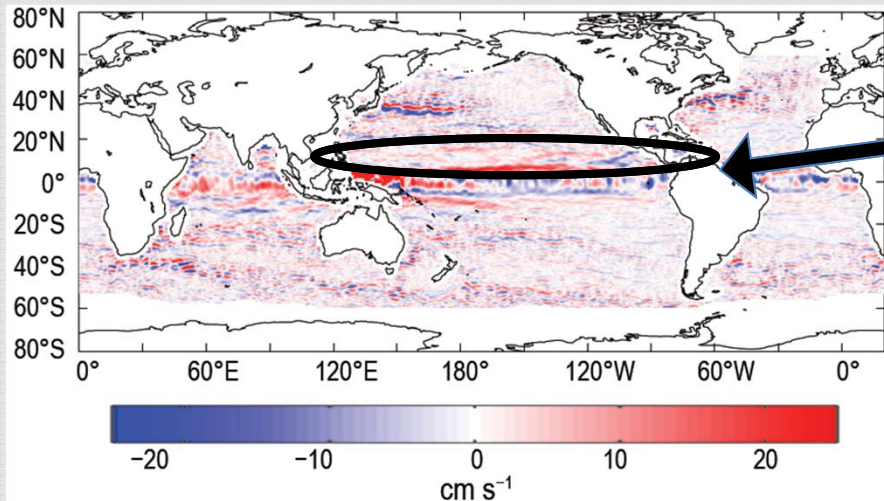


- Europe record warm for 2014, including close to two dozen individual countries.
- Many Asian countries among 10 warmest.
- Australia 3<sup>rd</sup> warmest for 2014.
- Mexico record warm for 2014 but eastern North America colder than average.



# “Not Quite El Niño”

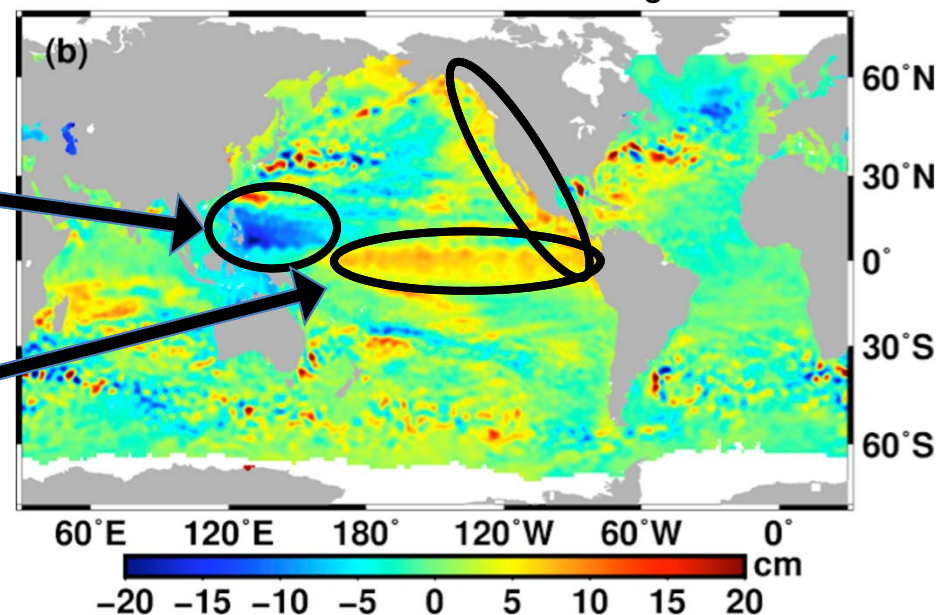
2014 East-West Surface Current Anomalies



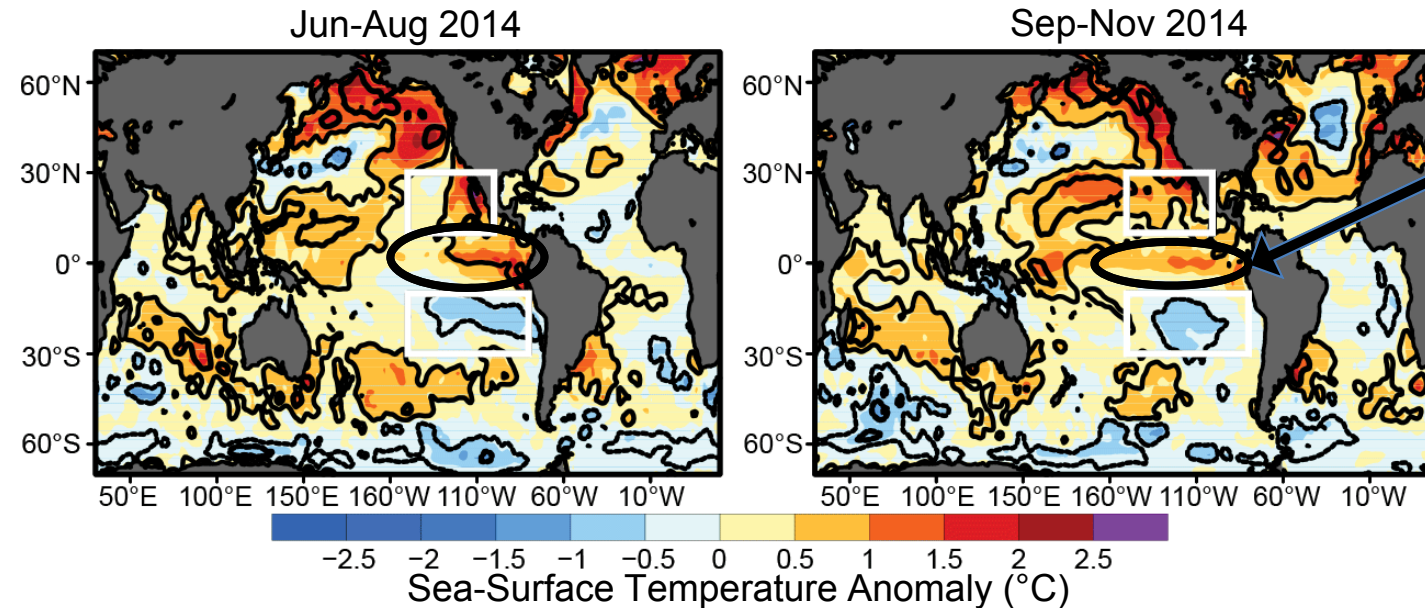
- Very strong eastward North Equatorial Countercurrent in 2014.

- Sea level falls east of the Philippines from 2013 to 2014.
- Sea level rises in the central and eastern equatorial Pacific, and off the west coast of North America.

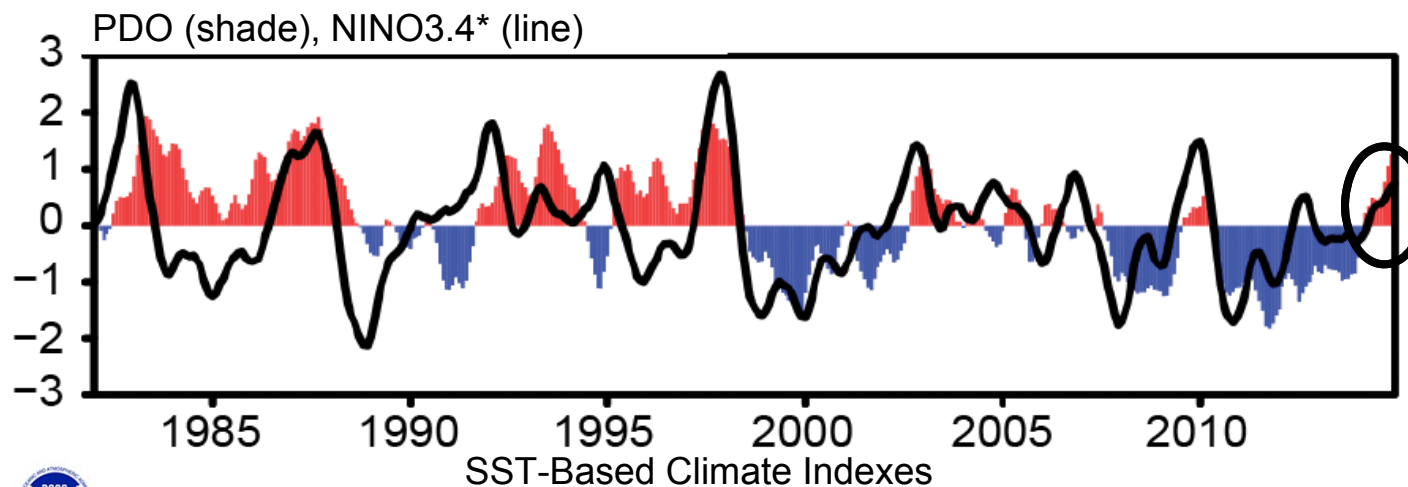
2014 - 2013 Sea Surface Height



# “Not Quite El Niño”



- Weak eastern equatorial Pacific warming in Summer and Fall 2014.

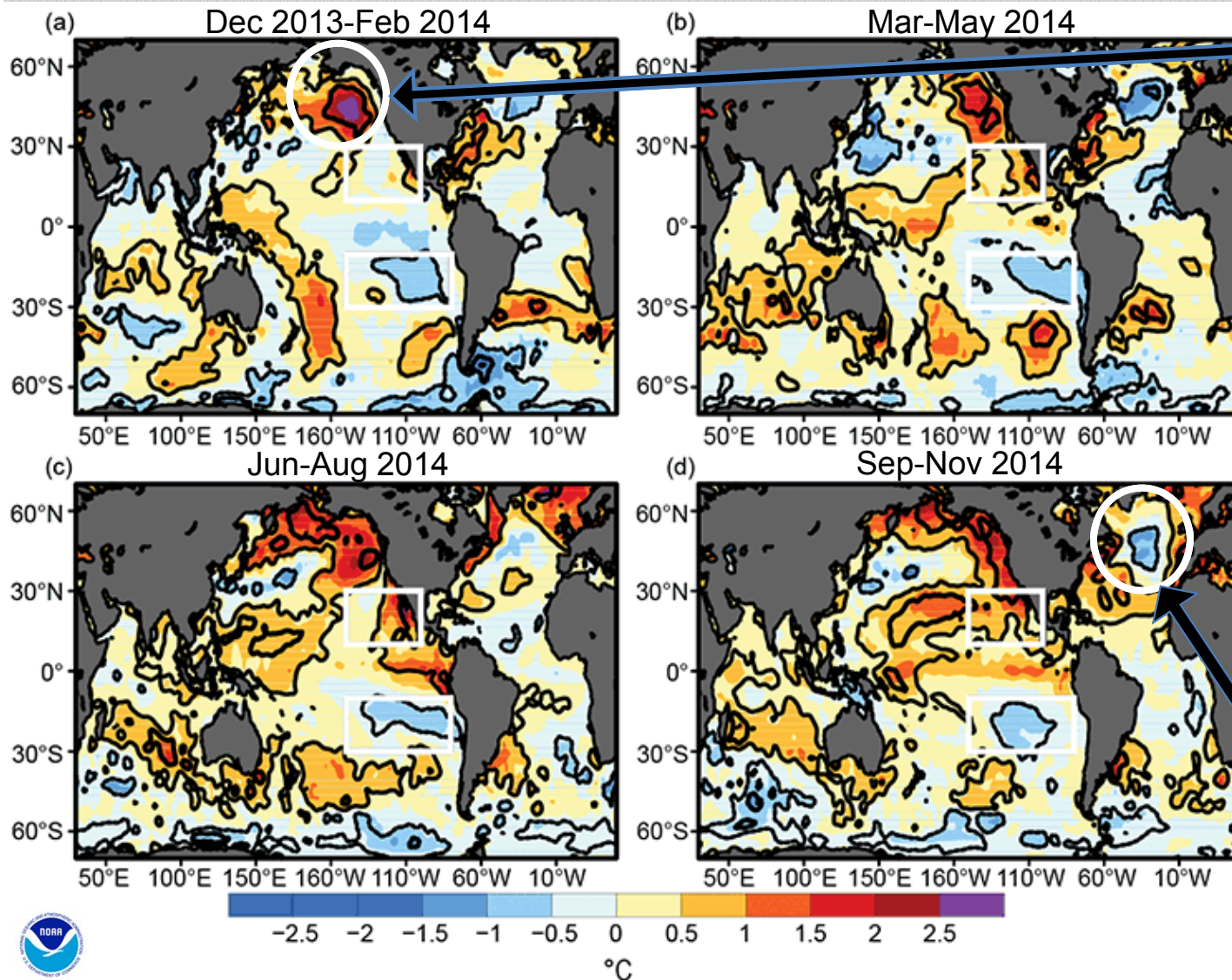


- Niño 3.4 index (black line) turns weakly positive in 2014.





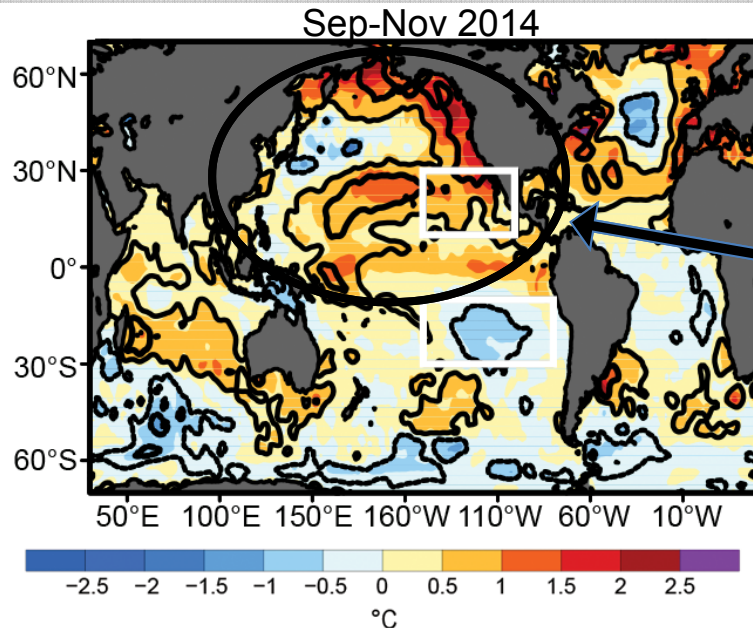
# “The Blob” . . . & Global Weather Patterns”



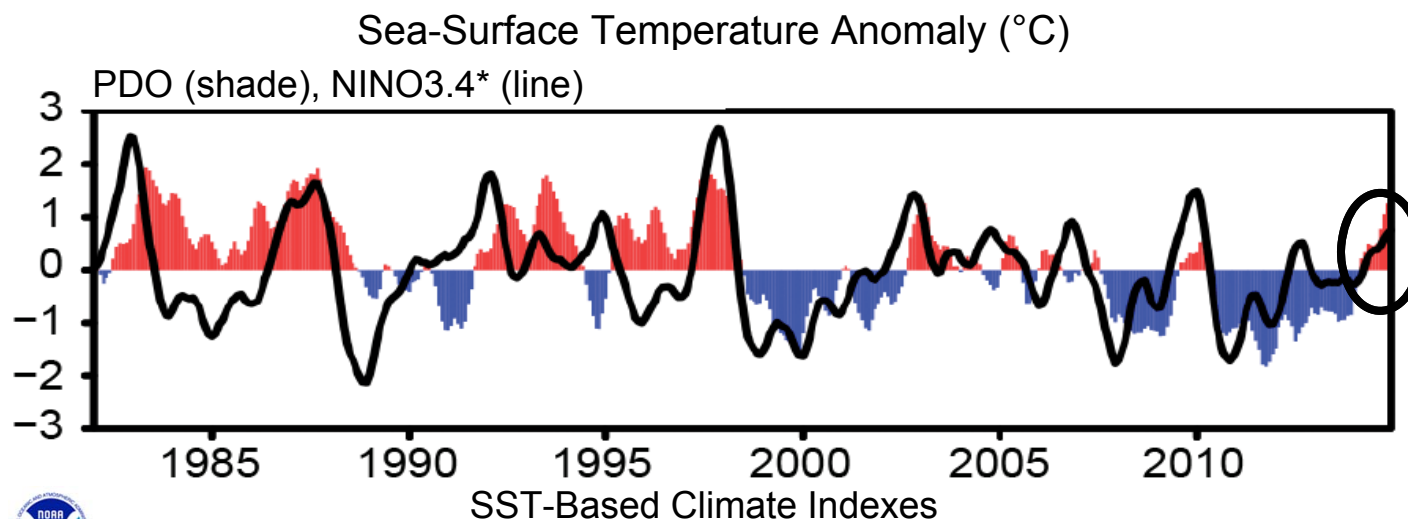
- Warm water, “The Blob”, builds up in NE Pacific with weak winds during winter 2013-14.
- Spreads along the coast in later seasons.
- Related to West Coast drought via the resilient ridge of high pressure in the region.
- Regional weather & ecosystem impacts.
- N. Atlantic cold patch & “The Blob” related through large-scale weather patterns.



# Pacific Decadal Oscillation Shifts to Warm Phase



- Waters in Tropical Pacific, off West Coast of North America, and off Alaska all warmer than normal.
- Waters east of Japan colder than normal.
- North Pacific Basin record high SSTs in 2014.



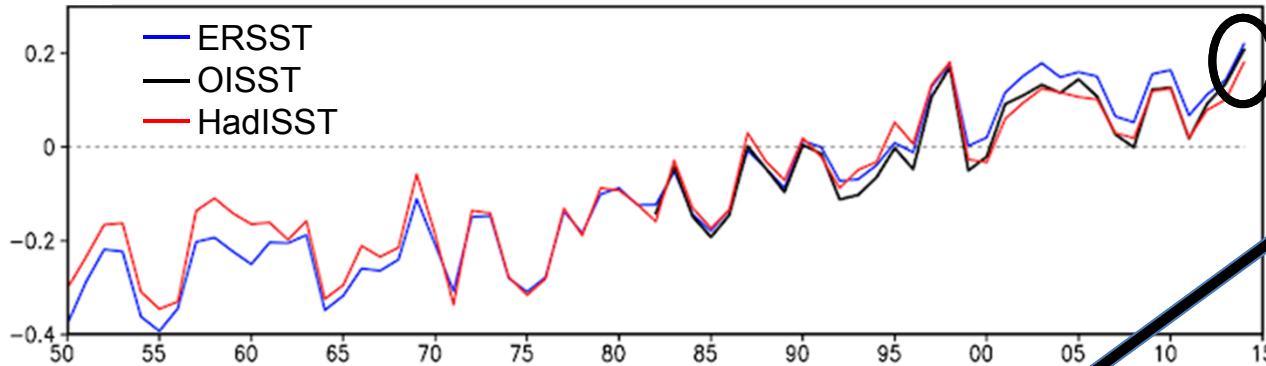
- PDO index (colors) shifts to a warm (red) phase in 2014.



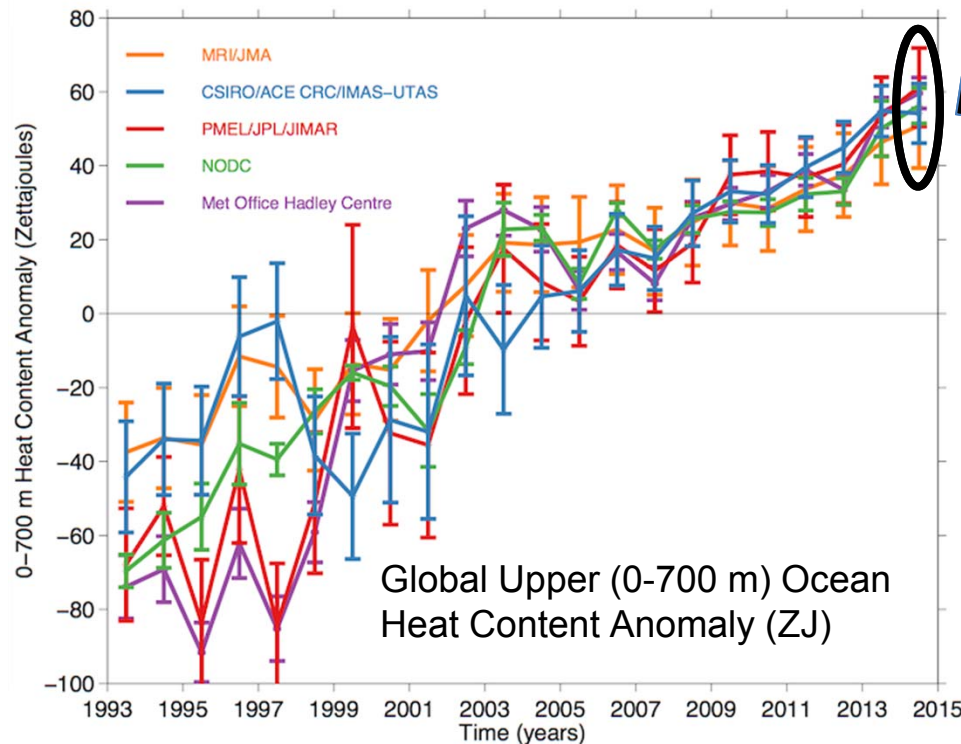


# Seas Warm, Land Ice Melts, and Waters Rise

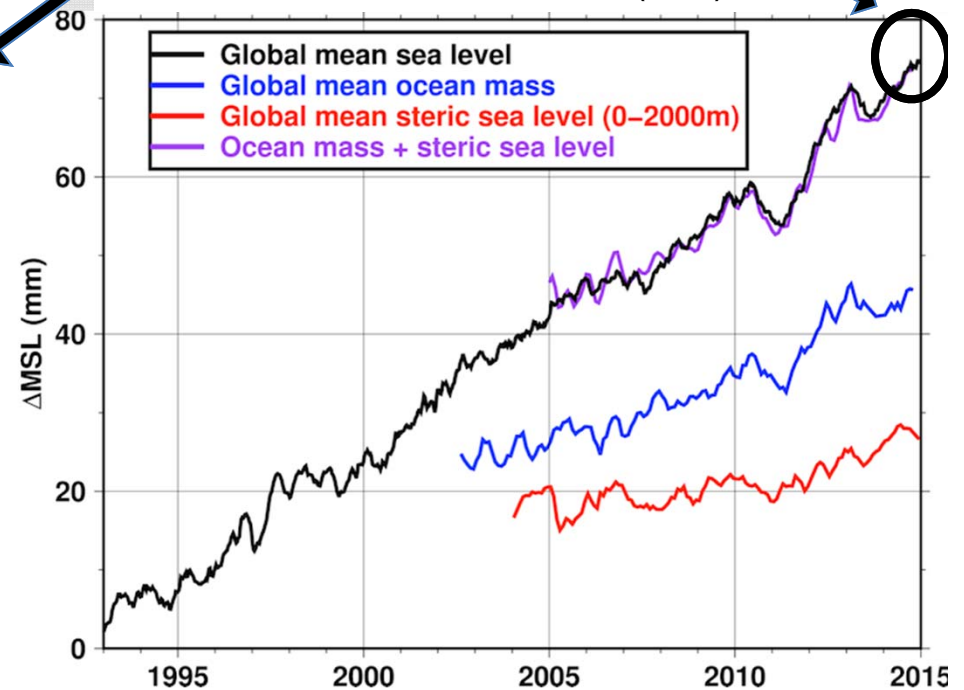
Global SST Anomaly ( $^{\circ}\text{C}$ )



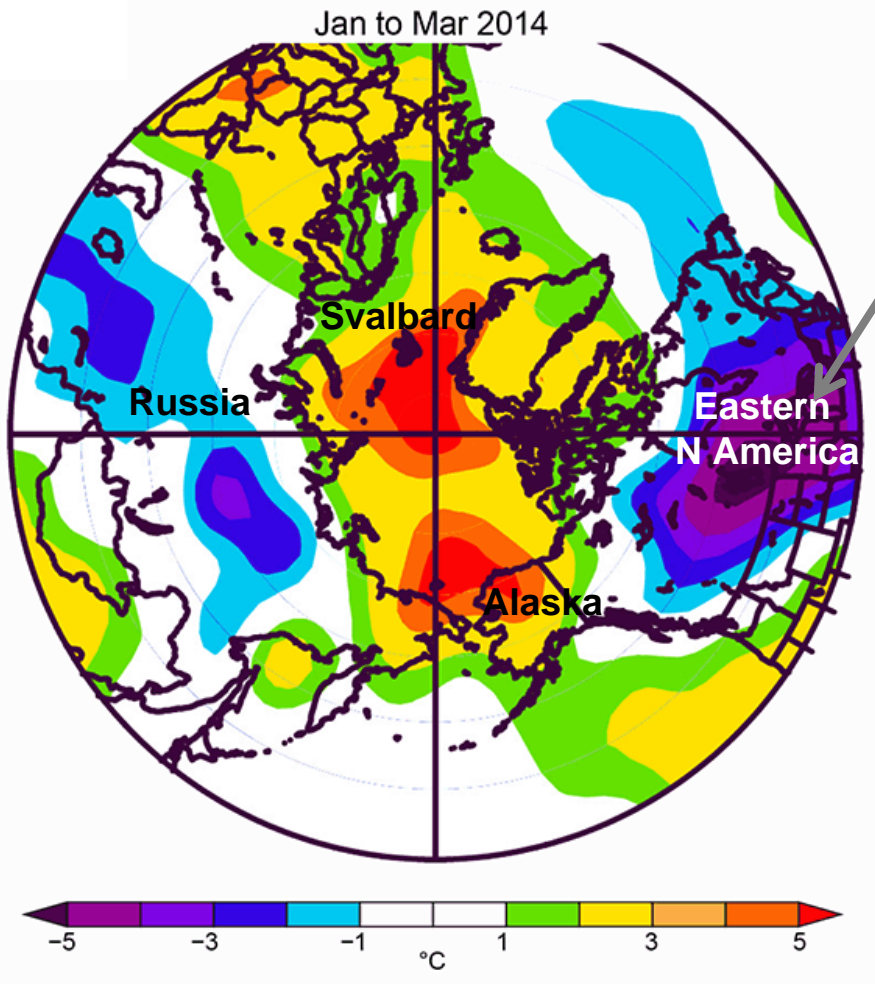
- 2014 Sea Surface Temperature warmest in 2 of 3 analyses.
- 2014 Upper (0-700 m) Ocean Heat Content Anomaly. highest in 4 of 5 analyses
- 2014 Sea Level record high.



Global Sea Level (mm)



# Polar Vortex Impacts Temperatures in the Arctic and Midlatitudes



NCEP/NCAR Reanalysis

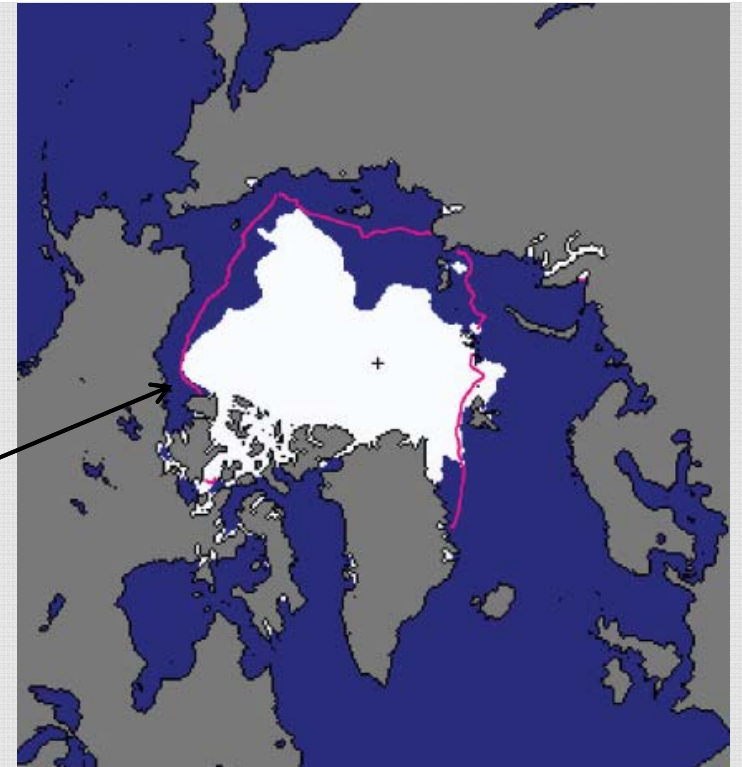
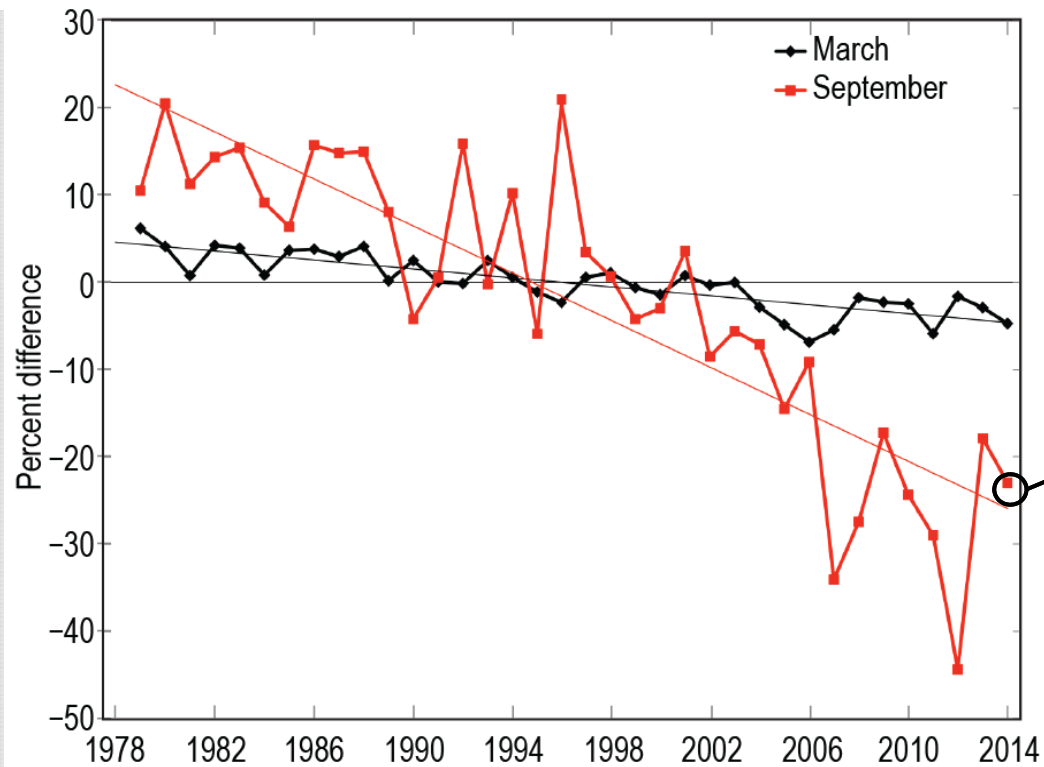
North-South excursions of the Polar Vortex had large impacts during early 2014:

- Alaska was more than 10°C / 18°F warmer than average during late January.
- Svalbard Airport was 8°C / 14°F warmer than average for January–March.
- Eastern North America was 5°C / 9°F cooler than average during January and February.
- Much of Russia was 5°C / 9°F cooler than average during January–March.



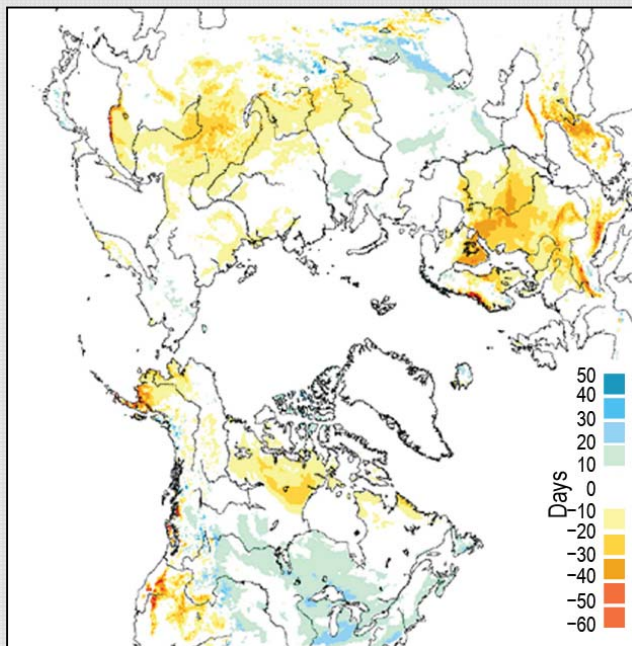
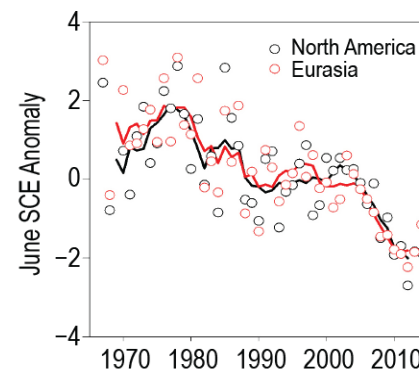
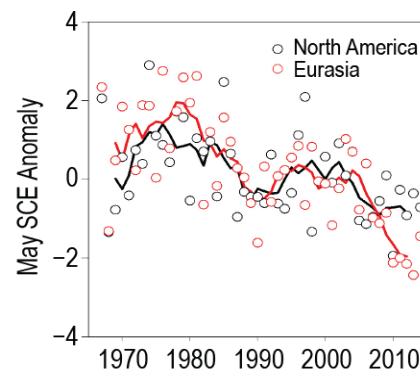
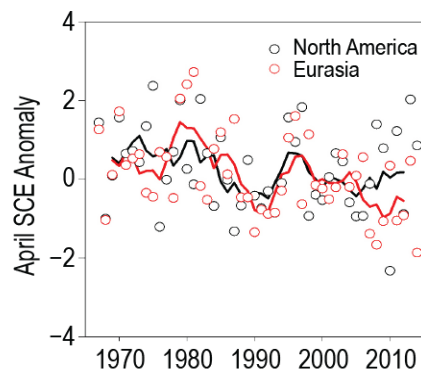


# Arctic Air is Warming and Sea Ice is Melting



- Minimum September sea ice extent: 18% below 1981–2010 average; 6th lowest in the satellite record (1979–2014).
- 8 lowest extents have occurred in past 8 years.
- September Arctic sea ice extent: declining at a rate of **-13.3% per decade**.

## ...and Snow is Melting Earlier

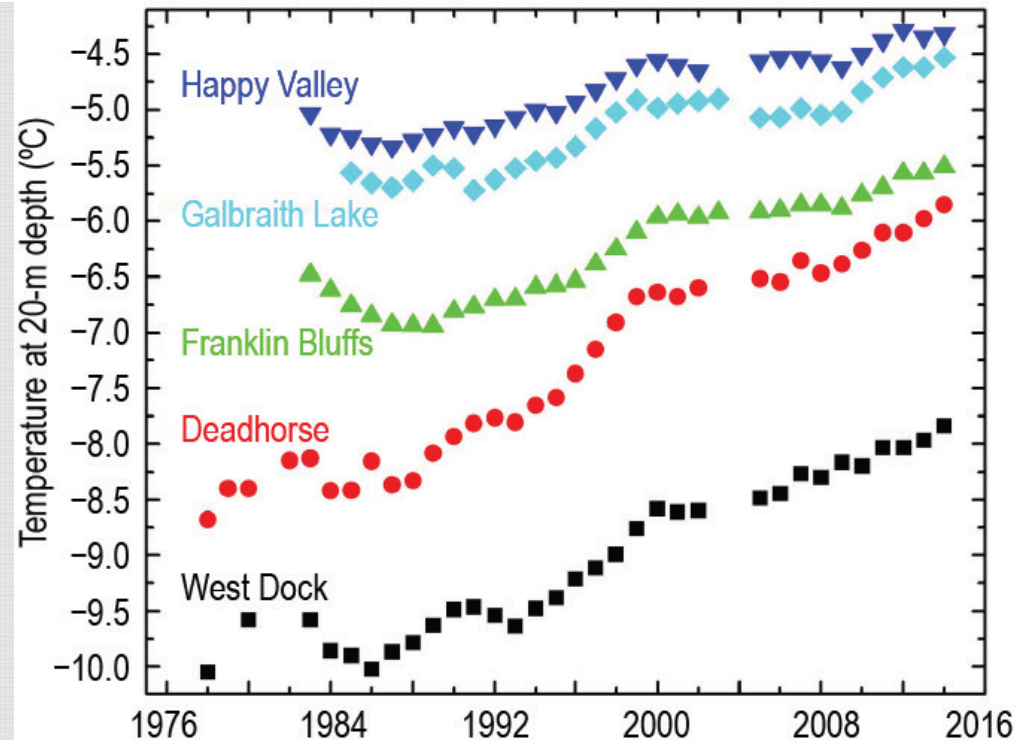
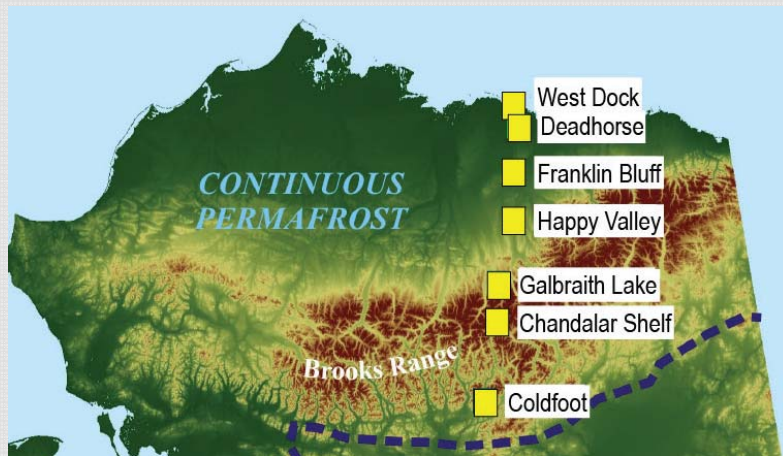


- In 2014 snow melt occurred 20–30 days earlier than the 1998–2010 average.
- April snow cover over Eurasia record low.
- May snow cover below average over Eurasia and North America for 9<sup>th</sup> time in past 10 years.
- June snow cover below average over Eurasia and North America for 10<sup>th</sup> consecutive year.
- June snow cover 3<sup>rd</sup> lowest over North America.



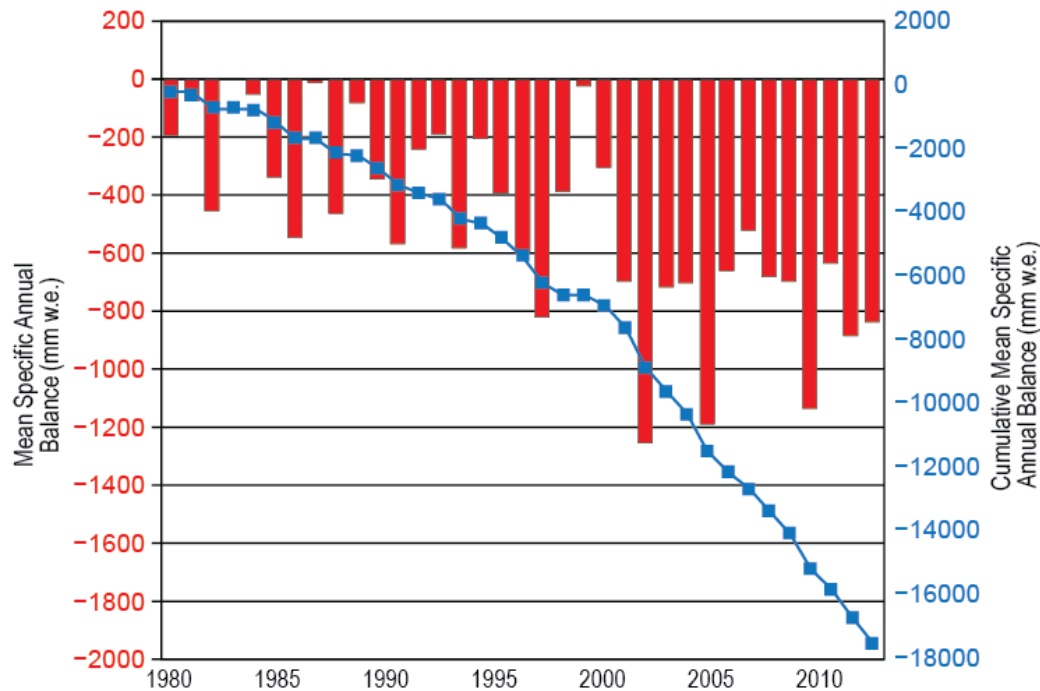
## ...and Permafrost is Melting

### Continuous Permafrost Region in Alaska



Following 2013, record and near-record high permafrost temperatures were observed in 2014 at 20-m depth at some stations on the North Slope of Alaska and in the Brooks Range.

# Glaciers Continue to Melt Across the Globe



Lemon Creek Glacier, Alaska  
September 2014



Courtesy of ©Chris McNeil

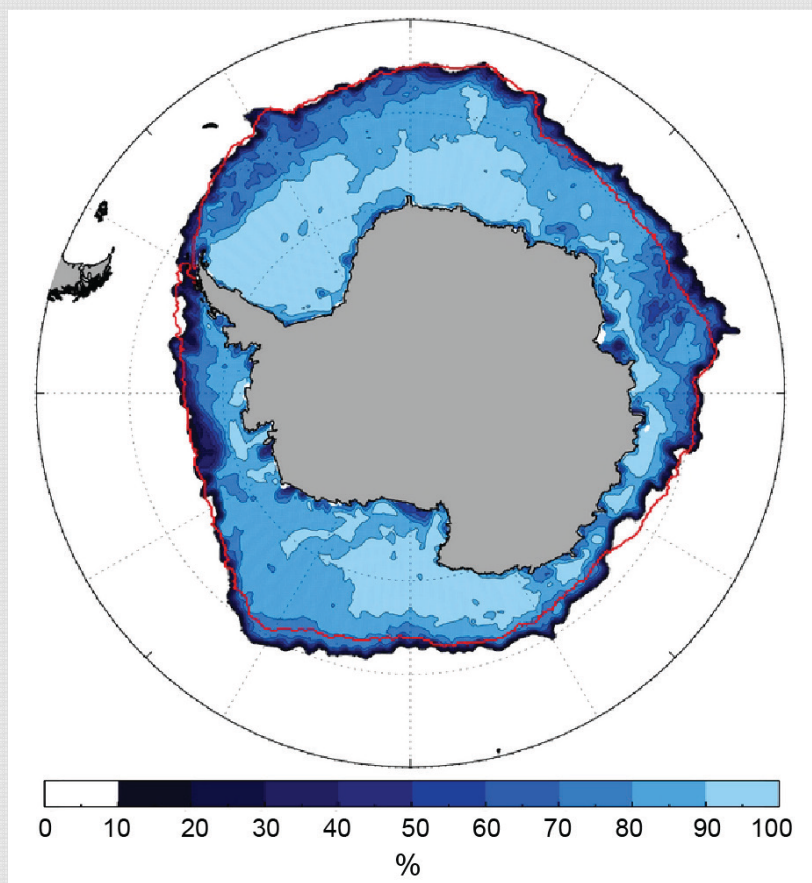
- Preliminary data suggests that 2014 will be the 31<sup>st</sup> consecutive year of negative glacier ice loss.

The area of retained snow cover is insignificant. For this glacier, an equilibrium balance requires 62% snow cover.

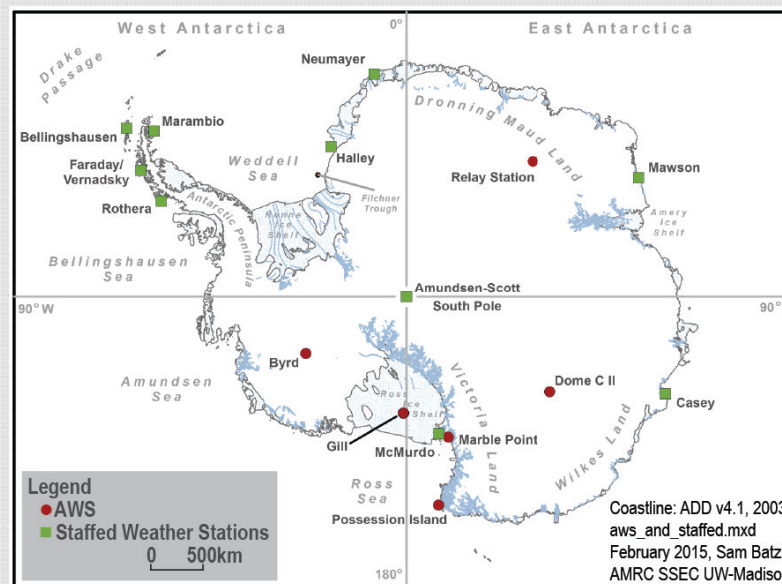


# Antarctic Sea Ice Extent Set New Records: Temperatures “Near-Average”

Sea ice extent  
Sept. 20, 2014



Map of Stations and Regions



- New daily large record ice extent set, and new monthly records from April to November.
- Temperatures were near-average for 2014, but with many large departures from average for months at a time in various regions.

# For More Information



Link to Full Report and Today's Presentation:

<http://www.ncdc.noaa.gov/bams-state-of-the-climate/2014.php>

Report Highlights:

<http://www.climate.gov/news-features/understanding-climate/state-climate-2014-highlights>

NOAA's National Centers for Environmental Information:

[www.ncdc.noaa.gov](http://www.ncdc.noaa.gov)

NOAA's Pacific Marine Environmental Laboratory:

[www.pmel.noaa.gov](http://www.pmel.noaa.gov)

Climate Portal: [www.climate.gov](http://www.climate.gov)

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